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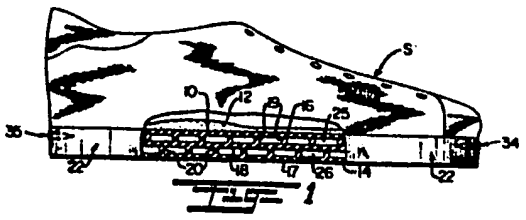
(54) **Impact absorbing member for footwear.**

(57) A midsole component 10 for a shoe comprises spaced upper and lower flexible closure layers 16,17 spaced from a resilient intermediate diaphragm 18 by upper and lower ribs 19. A peripheral closure strip 22 extends around the edges of layers 16, 17 and is joined thereto to enclose an air space therebetween. The ribs 19 divide the air space into a plurality of air pockets through which air can be circulated or redistributed via openings such as at the ends of ribs. One rib can isolate toe and heel portions of the airspace. Valves 34,35 at opposite ends of the midsole component allow air to be introduced under pressure into the air space.

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# IMPACT ABSORBING MEMBER FOR FOOTWEAR

This invention relates to an impact-absorbing member for footwear, in particular for a shoe.

Numerous designs have been advanced in an attempt to develop an impact absorbing or cushioning device for footwear which is both protective and resilient, which yields and flexes to the degree necessary for comfort yet has sufficient stability and resistance to absorb impact and provide a supportive shield between foot and ground. The addition of an intermediate sole structure, filler, or padding has been employed in the past to minimize muscular and skeletal stress and attendant fatigue experienced in the feet and legs after standing or walking for long periods of time. An example of this type of midsole structure is taught in U.S. Patent No. 3,834,046. The shoe sole of this earlier invention comprises flexible upper and lower sheets formed with a plurality of complementary aligned ridges and channels respectively. The ridges and channels are separated by an elastic diaphragm which yieldingly resists the compressive movement of the ridges into the open channels upon impact of the shoe against the ground.

According to the present invention there is provided an impact-absorbing member for a shoe, said member comprising spaced flexible closure layers substantially coextensive with one another, a diaphragm extending intermediately between said spaced closure layers, an outer peripheral closure strip extending from the outer peripheral edges of said spaced closure layers to form a sealed air space therebetween, and a plurality of spaced, parallel support ribs alternately extending in opposite directions away from connected relation to said diaphragm throughout the substantial length and breadth of said closure layers, and interconnecting said diaphragm and spaced closure layers.

By means of the present invention a midsole structure for footwear can be provided which efficiently absorbs a broad range of compressive forces encountered in walking and running, and readily adapts its shock-absorbing qualities to different surfaces, speeds and gaits, as well as to the weight of the wearer; and further wherein the air pressure within the midsole is evenly distributed and can be regulated by the wearer to establish optimum comfort.

The invention will now be particularly described, by way of example, with reference to the accompanying

drawings in which:-

Figure 1 is a side view in elevation of a preferred form of midsole component incorporated into a shoe structure in accordance with the present invention;

Figure 2 is a bottom plan view of the preferred form of midsole component illustrated in Figure 1;

Figure 3 is a cross-sectional view taken on line 3-3 of Figure 2;

Figure 4 is a cross-sectional view taken on line 4-4 of Figure 2; and

Figure 5 is a cross-sectional view taken on line 5-5 of Figure 2.

Referring to the drawings, the shock-absorbing member takes the form of a midsole component 10 positioned between an insole 12 and a lower or surface-engaging sole 14 of a standard shoe S. The midsole component 10 which is coextensive with the insole 12 and sole 14 is comprised of flexible upper and lower closure layers or sheets 16 and 17, respectively, which are connected to and spaced from a resilient intermediate diaphragm 18

by a plurality of upper and lower support ribs or bars 19 and 20 respectively. An outer peripheral closure strip 22 encircles the entire midsole component and extends continuously between outer peripheral edges of the upper and lower closure layers 16 and 17 so as to define a sealed air space therebetween. The upper and lower support ribs 19 and 20, in turn, separate the intermediate diaphragm 18 from the upper and lower closure layers and separate the air space into a plurality of air pockets through which air can be circulated and redistributed in response to the application of compressive force to the component.

The ribs 19 and 20 terminate a measured distance from the inner peripheral surface of the closure strip so as to form a limited lateral clearance space 24 between air pockets 25 and 26 respectively. In other words, the air pockets 25 formed along the upper compartment between the diaphragm 18 and upper and lower closure layers 16 and 17 will communicate with one another, and the lower air pockets 26 formed along the lower compartment between the diaphragm 18 and lower closure layer 17 will communicate with one another. Limited communication may be established between upper and lower compartments by openings 28, 29 at opposite front and rear ends of the midsole component.

The midsole component may be separated into heel and toe compartments 30, 31, respectively, by a pair of upper and lower ribs 19' and 20' which extend the entire width of the air space and become united with the inner peripheral edge of the closure strip. Valve stems 34 and 35 at opposite front and rear ends of the midsole component communicate with the interior air space formed within the upper compartment so as to permit the introduction of air under pressure into that air space. Each valve stem is of the type conventionally employed in inflatable items whereby air can be pumped into each valve or removed by depression of the valve stem at each end.

In the midsole component, each of the upper and lower layers 16, 17 and the intermediate diaphragm 18 is of uniform thickness, the diaphragm 18 being equally spaced spaced between the upper and lower layers 16 and 17 by the support ribs 19 and 20. Depending upon the material employed, each rib is given a cross-sectional width to resist bending but will compress under applied weight. Preferably, each set of support ribs 19 and 20 are uniformly spaced throughout the length of the midsole component, each rib being of uniform width or thickness throughout and that thickness substantially corresponding to the thickness of the upper and lower

layers 16 and 17. Again both the thickness and spacing of the ribs may be varied, for example, to lend greater resistance to applied weight in selected areas, such as the heel. The recess formed by lateral clearance 24 as described will accommodate the closure strip along opposite sides of the midsole component but at opposite ends web-like supports 40 extend between the upper and lower ribs 19 and 20 with the forward and rearward edges of the diaphragm united to an intermediate portion of each support web 40. The external surface of each support 40 is divided into upper and lower grooves by a horizontal rib 41. The closure strip 22 is preferably composed of a relatively thick, elongate resilient body having an exterior section 46 of a width to traverse the space between the upper and lower layers 16 and 17 and to overlap the peripheral edges of the layers 16 and 17 as at 47. The intermediate section 48 of the closure strip 22 projects between the upper and lower layers 16 and 17 and is divided into upper and lower spaced ridges by a central groove 50 which is of a width to receive the outer peripheral edge of the intermediate diaphragm 18 as well as the external ribs 41 of the webs 40. The ridges formed between the diaphragm 18 and the upper and lower layers 16 and 17 terminate short of the ends of the ribs 19 and 20 so as to form the lateral clearance space 24 and

permit air to circulate around the ends of the ribs between adjacent air pockets or channels. If desired, the communication between adjacent air pockets may be selectively controlled or limited by regulating the length of the ribs so that certain of the ribs will directly engage the inner peripheral surface of the closure strip, such as in the manner described with reference to the intermediate ribs 19' and 20'. The closure strip is united to the layers 16, 17 and the diaphragm 18 separately by application of a suitable adhesive, such as a thermal setting rubber cement so as to form a sturdy, airtight structure.

A preferred method of manufacturing the resilient midsole component is to mould the article in two steps: The upper and lower layers 16, 17, diaphragm 18 and support ribs 19, 20 as well as the end webs 40 are moulded in an injection mould which is split down the middle with bars mounted on each side and directed toward the centre so that when opposite sides of the mould are closed, the bars will extend the complete width of the void in the mould and project into holes in the opposite side. These bars will form the air pockets 25 and 26 in the finished components which will extend to the outside or peripheral edge of the component and be sealed later with the closure strip.

The two grooves formed around the perimeter of the midsole for interfitting engagement with the closure strip will be moulded slightly deeper than the closure strip along the two sides to vent air through the air pockets. In a separate moulding operation, the closure strip is formed of the desired length, then is coated along the ridges, except on their inner faces, with a thermal setting cement which will cure under heat to seal the closure strip.

Although the midsole component has been described using a single air valve at each end which communicates with the upper air space at the heel and toe and which upper compartments communicate with lower compartments through the openings 28 and 29, it will be apparent that two air valves may be employed at each end to individually communicate with each upper and lower air space and separately regulate the amount of air pressure. Materials selected in the composition of the midsole component may vary widely depending upon the particular application. In accordance with this invention, when the weight of a person is applied to the top surface of the midsole, the ribs 19 and 20 push against the diaphragm 18 which resists the initial force and, as the force increases, the air spaces between the ribs decrease in volume until the air

compresses to completely stop the force. When the force is removed from the resilient midsole, the compressed air and the resilient diaphragm 18 have a rebounding effect, pushing up against the bottom of the foot.

CLAIMS

1. An impact-absorbing member for a shoe, said member comprising spaced flexible closure layers substantially coextensive with one another, a diaphragm extending intermediately between said spaced closure layers, an outer peripheral closure strip extending from the outer peripheral edges of said spaced closure layers to form a sealed air space therebetween, and a plurality of spaced, parallel support ribs alternately extending in opposite directions away from connected relation to said diaphragm throughout the substantial length and breadth of said closure layers, and interconnecting said diaphragm and spaced closure layers.

2. An impact-absorbing member according to claim 1, including divider means for dividing said air space into separate toe and heel compartments and an opening provided to establish communication between the air spaces on opposite sides of said diaphragm.

3. A midsole impact-absorbing member for a shoe, said member comprising spaced upper and lower resilient closure sheets coextensive with one another and sized to traverse the length of the shoe, a flexible closure strip extending around the outer peripheral edges of

said upper and lower sheets to form a sealed air space between said sheets, support ribs extending in spaced relation to one another between said sheets and through said air space, intermediate divider means for dividing said air space into separate toe and heel compartments, and means for adjustably controlling the air pressure in said toe and heel compartments.

4. An impact-absorbing member according to claim 3 wherein said adjustable control means comprises regulating valve means extending through said closure strip for selective introduction of air into the interior of said member.

5. An impact-absorbing member according to claim 4 wherein said valve means are located at opposite ends of said member.

6. An impact-absorbing member according to claim 1 wherein said closure strip has ridges interfitting with complementary grooves formed around the outer peripheral edges of said diaphragm and spaced closure layers, at least selected of said ribs being of a width to form lateral clearance spaces between said ribs and closure strip to permit communication between adjoining air pockets formed between said ribs.

7. An impact-absorbing member according to any preceding claim, wherein said ribs traverse substantially the whole width of said air space in a direction transverse to the length of said layers.

8. An impact-absorbing member according to claim 3 wherein at least selected of said ribs are joined on upper and lower surfaces to facing surfaces of said upper and lower closure sheets.

9. An impact-absorbing member according to claim 3 including a diaphragm interposed between said closure layers and substantially coextensive with said sheets, and said support ribs extending from connected relation to opposite sides of said resilient diaphragm at spaced intervals across substantially the whole width of said closure layers.

10. An impact-absorbing member according to claim 9 wherein said ribs divide said air space into grooves at spaced intervals throughout said midsole above and below said resilient diaphragm, at least selected of said grooves being of a depth to permit venting of air from the air spaces.

11. A shoe comprising a midsole impact-absorbing

member in accordance with any one of the preceding claims.

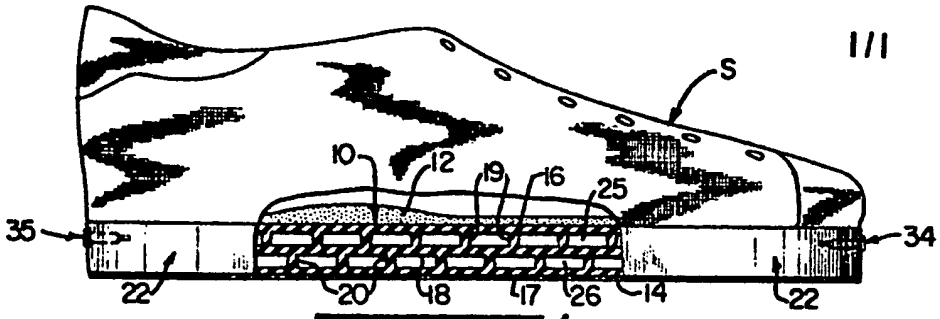


FIG 1

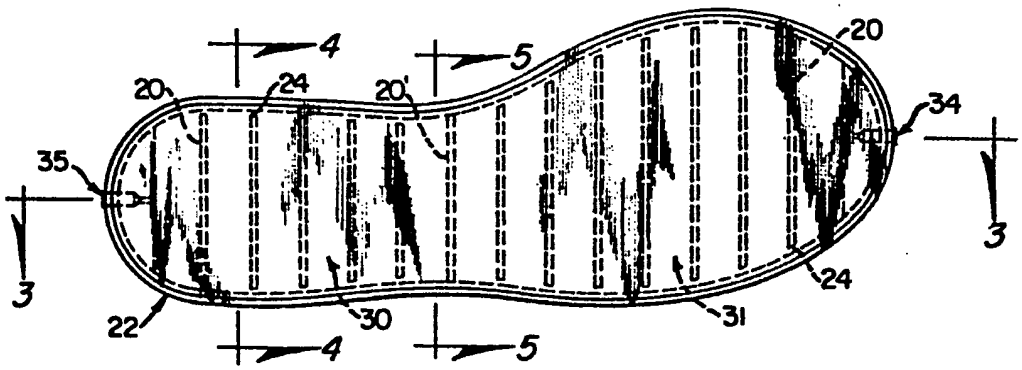


FIG 2

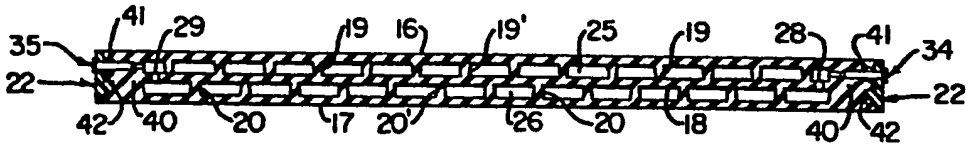


FIG 3

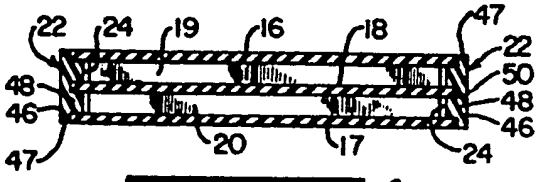


FIG 4

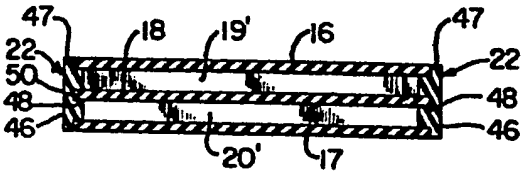


FIG 5

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# EUROPEAN SEARCH REPORT

0095357

## DOCUMENTS CONSIDERED TO BE RELEVANT

EP 83302925.9

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int. Cl. ³) |
|---|---|---|---|
| X,D<br>Y | US - A - 3 834 046 (D.M. FOWLER)<br>* Fig. 5,6,7 * | 1-11<br>1,2,5,6 | A 43 B 13/20 |
| X | US - A - 4 322 892 (M. INOHARA)<br>* Fig. 2,5 * | 1,3 | |
| Y | DE - B1 - 2 428 357 (H. FRITZSCHE)<br>* Fig. 2 * | 1 | |
| X | GB - A - 7 441/A.D. 1906 (R.E. CRETNEY)<br>* Fig. 1 * | 1,4 | |
| Y | US - A - 1 544 547 (G.S. BARKER)<br>* Fig. 3 * | 1,2,4,6 | TECHNICAL FIELDS SEARCHED (Int. Cl. ³) |
| Y | US - A-4 129 951 (CH. PETROSKY)<br>* Fig. 1 * | 1,4,6 | A 43 B |
| Y | WO - A1 - 82/00 571 (H. MARKER) (04-03-1982)<br>* Fig. 1,2 * | 1,4,5 | |

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| VIENNA | 04-08-1983 | SAMSEGGER |

### CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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